## CENTRE FOR RURAL TECHNOLOGY

### Ph.D Course Work

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Core Courses</strong></td>
<td></td>
<td></td>
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<tr>
<td>I</td>
<td>17CRTR0101</td>
<td>Supplementary Cementitious Material</td>
<td>4</td>
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<tr>
<td></td>
<td>17CRTR0102</td>
<td>Advanced Concrete Technology</td>
<td>4</td>
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<td></td>
<td>17CRTR0103</td>
<td>Recent Advances in Construction Materials</td>
<td>4</td>
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<td></td>
<td>17APRR0101</td>
<td>Research Methodology</td>
<td>4</td>
<td></td>
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<tr>
<td>II</td>
<td>17CRTR0204</td>
<td>Quantitative Techniques</td>
<td>4</td>
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<td></td>
<td>17CRTR02SX</td>
<td>Specific course to be prescribed by the Doctoral Committee</td>
<td>4</td>
<td>24</td>
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<td>Seminar ( 3 )</td>
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<td>Term paper/Topical Research</td>
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<tr>
<td>III</td>
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<td><strong>Semester onwards</strong></td>
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<tr>
<td></td>
<td>Research Credits</td>
<td>a) Project planning including literature collection, finalization of objectives and methodology</td>
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<td>32</td>
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<td></td>
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<td>b) Field/ Lab Studies, Data collection, compilation of results, statistical analysis, results and final conclusion.</td>
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<td></td>
<td>End of Program</td>
<td>Synopsis and thesis submission, final viva</td>
<td>6</td>
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</table>

### List of courses that are candidate centric (17CRTR02SX)

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>17CRTR02S1</td>
<td>Alkali-Activated Cements and Concretes</td>
</tr>
<tr>
<td>17CRTR02S2</td>
<td>High Performance Concrete</td>
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</tbody>
</table>
Learning Objectives:

The main objective of this course is to make the scholar aware of the various cementitious materials used as alternate for cement, and its role in concrete offering the strength and durability to the concrete

Learning Outcomes:

At the end of the course the scholar familiar in the types of cementitious materials available and selection of cementitious materials based on its effect will be used as alternate for cement

UNIT I THE ROLE OF SUPPLEMENTARY CEMENTING MATERIALS ON SUSTAINABLE DEVELOPMENT


UNIT II SILICA FUME

Introduction - Physical, Chemical and Mineralogical Properties - Hydration Reactions and Pozzolanic Activity - Effects of Silica Fume on the Mechanical Properties of Hardened Concrete - Effect of Silica Fume on Durability of Concrete - Effect on Volume Changes of Concrete - Application of Silica Fume in Mortars and Concretes.

UNIT III FLY ASH AND GRANULATED BLAST FURNACE SLAG


Granulated Blast Furnace Slag - Introduction - Physical, Chemical, and Mineralogical Properties - Effects of Slag on the Properties of Fresh Concrete - Effects of Slag on the Mechanical Properties of Hardened Concrete - Application of Slag in Concrete.

UNIT IV METAKAOLIN AND RICE HUSK ASH
**Metakaolin** - Introduction – Production - Physical, Chemical, and Mineralogical Properties - Effects of Metakaolin on the Properties of Fresh Concrete - Effects of Metakaolin on the Mechanical Properties of Hardened Concrete - Effect of Metakaolin on Durability of Concrete - Effect of Metakaolin on Carbonation of Mortars and Concretes.


**UNIT V NANO MATERIALS FOR CONCRETE**


**REFERENCES:**

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Learning Outcomes:

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UNIT I FRESH AND HARDENED CONCRETE


UNIT II ADMIXTURES

Mineral admixtures- fly ash, silica fume, blast furnace slag, silica fume, metakaoline, Rice husk ash, quartz powder. Chemical admixtures, Plasticizers, Super plasticisers, Accelerators, Retarders, Air entraining admixtures, alkali aggregate expansion inhibiting admixtures, workability admixtures, corrosion inhibiting admixtures and bonding admixtures.

UNIT III CONCRETE MIX DESIGN

Principles and Methods, Statistical Quality control, Concrete Rheology, Maturity concept, Concrete mixes for different strength as per IS:456 – 2000, Factors causing variations, field control, statistical quality Control, quality measurement in concrete construction. Concrete mix design based on BIS method, ACI method, IRC 44 method and Road Note number 4 method.

UNIT IV MECHANICAL AND MICRO STRUCTURAL PROPERTIES OF HARDENED CONCRETE

Characteristic strength, compressive, tensile and flexure of concrete, tests on hardened concrete, modulus of elasticity, effect of w/c ratio and admixture on strength properties of concrete. Non-Destructive tests on concrete- Scanning Electron Microscope (SEM), Energy Dispersive X-ray Technique (EDAX), FTIR (Fourier Transform Infrared Spectrograph).
UNIT V DURABILITY OF CONCRETE


REFERENCES:

2. M.S.Shetty, Concrete Technology, S.Chand and Company, new Delhi, 2012
Learning Objectives:

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Learning Outcomes:

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UNIT I  FIBRE REINFORCED CONCRETE

Foams and light weight materials - fibre reinforeced concrete - Types of fibres – workability - mechanical and physical properties of fibre reinforced concrete.

UNIT II  INDUSTRIAL WASTE MATERIALS IN CONCRETE

Industrial waste materials in concrete - their influence on physical and mechanical properties and durability of concrete - Concrete at high temperature.

UNIT III  CORROSION OF CONCRETE AND REINFORCING STEEL


UNIT IV  FERROCEMENT, FIBRES AND COMPOSITES


UNIT V  POLYMERS IN BUILDINGS

Structural elastomeric bearings and resilient seating. Moisture barriers, Polymer foams and polymers in building Physics, Polymer concrete composites, ceramics, fly ash quarry dust.

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Learning Outcomes:

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UNIT I STRAIN GAUGES AND APPLICATIONS

Types - Mechanical strain gauge, optical strain gauge, inductance and capacitance strain gauge – pneumatic strain gauges - strain rosettes. Strain gauge circuit - Measurement of static and dynamic strain using potentiometer and Wheatstone bridge circuits - Effect of transverse strains – strain recorders and load cells, calibration of testing machines, beam type load cell – proving ring – torque measurements Gauge construction, adhesive and mounting methods – gauge factor – environmental effects.

UNIT II THEORY OF PHOTOELASTICITY


UNIT III MODEL ANALYSIS
UNIT IV INSTRUMENTATION


UNIT V MICROSTRUCTURAL ANALYSIS

Scanning Electron Microscope (SEM), Energy Dispersive X-ray Technique (EDAX), FTIR (Fourier Transform Infrared Spectrograph), Transmission Electron Microscopy (TEM).

REFERENCES: